CHAPTER V

CONCLUSION

5.1 Green synthesis of platinum nanoparticles

In this work, the efficiency of soluble starch as a reducing and a stabilizing agent under acidic-alkaline treatment is systematically studied. The degraded intermediates with reducing potential (i.e., small molecules containing aldehyde and α-hydroxy ketone moieties) are concomitantly generated when the alkaline concentration is greater than 0.025 M. The *in situ* generated species could completely reduce platinum ions (20 mM) and sufficiently stabilize the obtained platinum nanoparticles of uniform particle size (2–4 nm). The reduction is efficient and rapid as a complete conversion is achieved within 5 minutes. In a stronger alkaline condition, the platinum nanoparticles tend to aggregate and form a bigger domain because of the extensive degradation generates small starch fragments with less stabilization efficiency. This observation suggests that starch is a promising green material which could be chemically treated and transformed to a powerful reducing agent and stabilizer for the synthesis of metal nanoparticles. The obtained Pt NPs are expected to have a good catalytic activity. The ongoing glycerol oxidation by this green Pt NPs is being investigated.

5.2 Green synthesis of supported platinum heterogeneous catalyst

We successfully synthesized Pt NPs/HT heterogeneous catalyst using a “Green” synthesis approach. Hydrotalcite-supported platinum nanoparticles catalyst (Pt NPs/HT) was prepared by sol immobilization method. Soluble starch was found to be simultaneous effective as a reducing and a stabilizing agent for the synthesis of Pt NPs. Uniform Pt NPs (2-4 nm) is obtained. These are then immobilized onto the HT support to obtain Pt NPs/HT. The catalytic activity is evaluated for selective oxidation of glycerol in a base-free aqueous solution using molecular oxygen as an oxidant under atmosphere. Pt NPs/HT catalyst shows a high selectivity (68%) towards glyceric acid (yield, 43%). The catalysts were removed from the solution by simple filtration. The remaining solution was analyzed by the leaching test to confirm the absence of catalyst in the solution. In addition, the catalyst could be recycled and used for up to three times after it showed a slight reduction in its catalytic efficiency (63%: pure catalyst, 56%: 3 times-recycled). However, there is no significant change in its selectivity towards glyceric acid (68%: pure catalyst, 71%: 3 times-recycled)

5.3 Green synthesis of extra-long silver fiber and application as a platinum hollow structure template

Centimeters long pentagonal silver microfibers with aspect ratio as high as 7500 (Length: 1.5 cm, Diameter: 2 μm) were galvanically synthesized within 48 h from silver nitrate and a commercial aluminum foil. Silver wool consisting of entangled microfibers was directly grown from the surface of the foil under an ambient condition without the assistance of any capping agent. An addition of extra sodium nitrate is essential to enable the development of fiber structure. It was experimentally verified that a prior formation of decahedron microcrystals and pentagonal rods were pivotal for the development of extra-long pentagonal microfibers. The well-defined and easy-to-handle silver microfibers could be used as templates for fabrication of platinum pentagonal hollow fibers. The hallow fiber, although brittle, still retain the long fiber structure of the original template even after the removal of silver chloride precipitates. These hollow fibers with nanometer thick wall have great potential applications as catalyst.